PATENT CLAIMS

1. Method for detecting the shutter opening angle (light or dark sector) of an adjustable rotating shutter mounted in a film camera which consists of a circular segment or circular sector shaped shutter vane driven through a shutter shaft by a shutter motor, and of a shutter adjustment vane mounted coaxial with the shutter vane and adjustable relative thereto by means of a shutter adjustment vane motor,

characterised in that

the position of the shutter vane (2) and the position of the shutter adjustment vane (3) are detected during rotation of the rotatable shutter (1) and the difference between the two positions is formed as a value for the shutter opening angle or the light or dark sector of the rotatable shutter (1).

2. Method according to claim 1, **characterised in that** the absolute position of the shutter vane (2) and the absolute position of the shutter adjustment vane (3) is detected with a resolution of *n* steps during one revolution of the rotatable shutter (1) and the shutter opening angle of the rotatable shutter (1) is determined from the equation

$$\alpha = P_{BF} - P_{VF}\ 8\ 360° /n$$

with P_{BF} the position of the shutter vane and

P_{VF} the position of the shutter adjustment vane

wherein with an angle α which is less than 0° the value is increased around 360° so long until it is greater than or equal to 0° or with an angle α which is greater than or equal to 360° the value is reduced around 360° so long until it is less than 360°.

3. Method according to claim 2, **characterised in that** the absolute positions of the shutter vane (2) and the shutter adjustment vane (3) are determined from coded sensor tracks.

4. Method according to claim 3, **characterised in that** the absolute positions of the shutter vane (2) and the shutter adjustment vane (3) are detected as a sine and cosine signal per revolution of the rotating shutter (1) and the shutter opening angle of the rotating shutter (1) is determined through an arctan calculation from the sine and cosine signal.

5. Method according to at least one of the preceding claims, **characterised in that** the positions of the shutter vane (2) and the shutter adjustment vane (3) are detected incrementally, that at least one index or reference mark signal is provided per revolution of the rotatable shutter (1) and that the detected incremental signals are stored with the appearance of the reference mark signal and the shutter opening angle (α) of the rotatable shutter (1) is determined from the equation

$$\alpha = (Z_{BF} - Z_{VF} + K) * 360/n$$

with Z_{BF} the counter state of the shutter vane
Z_{VF} the counter state of the shutter adjustment vane and
O a constant off-set which is determined from the equation

$$O = I_{BF} + I_{VF} + K$$

with I_{BF} the index position of the shutter vane

I_{VF} the index position of the shutter adjustment vane and

K a calibrating value

wherein with an angle α which is less than 0° the value is increased around 360° so long until it is greater than or equal to 0° or with an angle α which is greater than equal to 360° the value is reduced around 360° so long until it is less than 360° and

the calibrating value (K) is a correcting value arising from the relationship of the reference marks which are coupled to the revolutions of the shutter vane (2) and the revolutions of the shutter adjustment vane (3).

6. Method according to at least one of the preceding claims, **characterised in that** the absolute positions of the shutter vane (2) and the shutter adjustment vane (3) are determined from distance-coded reference marks.

7. Method according to at least one of the preceding claims for detecting, adjusting and/or regulating the shutter opening angle (light or dark sector) of the rotatable shutter which is mounted in a film camera, **characterised in that** the light or dark sector determined from the difference between the positions of the shutter vane (2) and the shutter adjustment vane (3) is supplied as actual value to a shutter adjustment vane position regulating device (12) at which an ideal value of the light or dark sector inputted through an interface (15) to the camera control, is emitted and which forms from the difference between the ideal and actual value of the light or dark sector a setting variable for the shutter adjustment vane motor (33).

8. Method according to at least one of the preceding claims, **characterised in that** the positions of the shutter vane (2) and shutter adjustment vane (3) are interpolated before the formation f the difference.

9. Method according to at least one of the preceding claims, **characterised in that** a mechanical locking or unlocking of the shutter adjustment vane (3) is scanned with predetermined frequency and in the event of mechanical locking of the shutter adjustment vane (3) a control of the shutter adjustment vane motor (33) is blocked.

10. Method according to at least one of the preceding claims, **characterised in that** the position signals indicating the position of the shutter vane (2) and the shutter adjustment vane (3), the absolute value of the light or dark sector of the adjustable

rotatable shutter (1) and the signals scanning the mechanical locking or unlocking of the shutter adjustment vane (3) are processed in a control logic (11).

11. Method according to claim 10, **characterised in that** the control logic (11) initialises the position detections.

12. Method according to at least one of the preceding claims, **characterised in that** the setting value for the shutter adjustment vane motor (33) is transferred contactlessly by the shutter adjustment vane position regulating device (12) to the shutter adjustment vane motor (33).

13. Device for detecting the shutter opening angle (light or dark sector) of an adjustable rotatable shutter mounted in a film camera which consists of a circular segment or circular sector shaped shutter vane driven through a shutter shaft by a shutter motor, and of a shutter adjustment vane mounted coaxial with the shutter vane and adjustable relative thereto by means of a shutter adjustment vane motor,

characterised by

- a sensor (7) coupled to the shutter vane (2)for scanning the shutter vane position and emitting shutter vane position signals

- a sensor (8) coupled to the shutter adjustment vane (3) for scanning the shutter adjustment vane position and emitting shutter adjustment vane position signals

- a position counter (10) charged with the shutter vane position signals and the shutter adjustment vane position signals for forming the difference between the shutter vane position signals and the shutter adjustment vane position signals.

14. Device according to claim 13, **characterised in that** the sensors (7, 8) consist of absolute angle measuring instruments with several code tracks (701, 703-706) mounted on a graduated plate (70b) and scanning devices (716, 717) assigned to the code tracks (701, 703-706).

15. Device according to claim 14, **characterised in that** the absolute angle measuring instruments consist of absolute coders, resolvers or pole wheel sensors.

16. Device according to claim 13, **characterised in that** the sensors (7, 8) consist of incremental angle measuring instruments with a periodic incremental track (701) mounted on a graduated plate (70a) and a reference mark track (702) which has at least one reference mark fixing the absolute position of the graduated plate (70a) and assigning this to a measuring step, and of scanning devices (71, 715) associated with the incremental and reference mark track (701, 702).

17. Device according to claim 16, **characterised in that** the reference mark track has distance-coded reference marks on which reference marks are made with defined variable spacing.

18. Device according to at least one of claims 14 to 17, **characterised in that** the sensors (7, 8) have graduated plates (70c) with additional sine and cosine tracks (707, 708) and that a computing unit connected in on the output side of the scanning device detecting the sensor signals of the sine and cosine signals is charged with the sine and cosine signals and issues arctan values calculated from the sine and cosine signals.

19. Device according to at least one of the preceding claims, **characterised in that** the sensors (7, 8) are formed as absolute or incremental angle measuring instruments with photo electric, magneto resistive or permanent magnetic scanning.

20. Device according to at least one of the preceding claims 13 to 19 for detecting, setting and/or regulating the shutter opening angle (light or dark sector) of the adjustable rotatable shutter mounted in a film camera,

characterised by

- a control logic (11) charged with the difference between the shutter vane position signals and the shutter adjustment vane position signals and connected to an interface (19) for the control of the film camera and

- a shutter adjustment vane position regulating device (12) which is charged on the input side with the difference of the shutter vane position signals and the shutter adjustment vane position signals as well as with an ideal value issued by the control of the film camera through an interface (15) for the shutter adjustment vane (3) or for the light sector (dark sector) of the adjustable rotatable shutter (1) and on the output side issues a setting variable for the shutter adjustment vane motor (33).

21. Device according to at least one of the preceding claims 13 to 20, **characterised by** a safety scanning device (9) mounted in the rotational area of the adjustable rotatable shutter (1) for detecting the light or dark sector of the adjustable rotatable shutter (1) whose output is connected to the control logic (11) for issuing absolute values of the light or dark sector of the adjustable rotatable shutter (1).

22. Device according to claim 20 or 21, **characterised in that** the control logic (11) is connected on the input side to a scanning device (14) for detecting the mechanical locking of the shutter adjustment vane (3) and blocks the control of the shutter adjustment vane motor (33) in the event of activated mechanical locking of the shutter adjustment vane (3).

23. Device according to at least one of the preceding claims 13 to 22, **characterised in that** the shutter adjustment vane position regulating device (12) is connected through a device (13) for controlling the shutter adjustment vane motor (33) to an energy and signal transfer device (61, 62, 63, 64, 65, 68, 69) for controlling or feeding the shutter adjustment vane motor (33).

24. Device according to at least one of the preceding claims 13 to 23, **characterised in that** the shutter adjustment vane position regulating device (12) is connected through the energy transfer device (61, 62, 63) to a motor amplifier (66) as well as through the signal transfer device (64, 65, 68, 69) to a processor (60) for controlling and regulating the shutter adjustment vane motor (33).

25. Device according to claim 24, **characterised in that** the control device of the motor amplifier (66) connected to the energy transfer device (61, 62, 63) is connected to a first output of the processor (60) which is connected by a first input to the output of an actual value measuring amplifier (67) which is connected to a potentiometer transmitter (34) coupled to the shutter adjustment vane motor (33), and that each one second input and output of the processor (60) is connected to the bi-directional signal transfer device (64, 65; 68, 69).

26. Device according to one of the preceding claims 23 to 25, **characterised by** a contactless energy transfer device (61, 62, 63) and/or a contactless signal transfer device (64, 65, 68,

27. Device according to one of the preceding claims 23 to 26, **characterised in that** the energy transfer device (61, 62, 63) consists of a divided transformer (62) operated at high frequency and whose primary winding (621) is connected to a direct current converter (61) on the primary side and whose secondary winding (622) is connected to a direct current converter (63) on the secondary side.

28. Device according to one of the preceding claims 23 to 27, **characterised in that** the signal transfer device (64, 65; 68, 69) each consists of an optical transmitter (64, 68) and an optical receptor (65, 69) for the bi-directional signal exchange between the shutter adjustment vane position regulating device (12) and the processor (60).

29. Device according to one of the preceding claims 23 to 27, **characterised in that** the signal transfer device consists of an inductive signal transfer device for the bi-directional signal exchange between the shutter adjustment vane position regulating device (12) and the processor (60).

30. Device according to one of the preceding claims 23 to 27, **characterised in that** the signal transfer device consists of a carrier frequency signal transfer device for the bi-directional signal exchange between the shutter adjustment vane position regulating device (12) and the processor (60) with which the signals are modulated up with a carrier frequency to the energy supply of the shutter adjustment vane motor (33).

31. Device according to at least one of the preceding claims 13 to 24, **characterised in that** the shutter adjustment vane position regulating device (12) controls the shutter adjustment vane motor (33) through a motor end stage (13) and a rotational connection or a slip ring (6).

32. Device according to at least one of the preceding claims 13 to 30, **characterised in that** the sensors (7, 8) for scanning the shutter vane position and the shutter adjustment vane position are coupled to the shutter shaft (20) and the shutter adjustment vane shaft (30).

33. Device according to at least one of the preceding claims 13 to 31, **characterised in that** the shutter shaft (20) is connected to a shutter drive through gearing (21).

34. Device according to at least one of the preceding claims 13 to 32, **characterised in that** the shutter adjustment vane (3) is connected to the shutter adjustment vane motor (33) through a shutter adjustment vane shaft (30) and a gearing (31, 32) guided through the shutter shaft (20).